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THE MUSCULAR FACTORS CONCERNED IN ANKLE-CLONUS.[1]

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In a case of trauma of the spinal cord, seen lately in consultation with Dr. Guy Hinsdale, I observed that the very remarkable ankle-clonus present was the work of the soleus muscle alone; the gastrocnemius was entirely passive.

I confess to having been surprised, as I had always taken for granted that the whole group was concerned. In fact, in Gowers' and in Dercum's works on nervous diseases the gastrocnemius is distinctly mentioned as the active agency in causing ankle-clonus. Usually no muscle is mentioned in the text-books. Oppenheim, the latest, is thus silent.

I at first supposed that Dr. Hinsdale's case was an exception to the rule, but on examining a number of cases of spastic conditions I was interested to observe that in all of them the soleus alone was active in clonus of the ankle. The proof is readily to be had in thin spastic patients.

To test the matter let the patient be at rest—supine—with the leg fully flexed on the thigh. Then, grasping the belly of the relaxed gastrocnemius with one hand, with the other start the clonus. It will be observed that, as the foot is flexed by the hand, the gastrocnemius is felt to become tense, but that as extension occurs no motion is felt in the belly of that muscle. The active agent in the series of extensions which we thus observe can only be the soleus. In fact, if now during clonus we keep the leg flexed and press the fingers in under the gastrocnemius, and especially when on the inside of the leg the soleus can be felt behind the gastrocnemius masses, we shall feel the soleus harden each time the foot is extended.

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[1] Read before the Philadelphia Neurological Society, March 25, 1902.

This proof we obtain best in thin persons, but any one can obtain it on himself in a very simple way by calling forth what I may call normal clonus.

This phenomenon is not, I think, mentioned in the books, and yet is a familiar fact.

To get this clonus let any healthy man sit forward on the edge of a chair with the leg in at least 45° of flexion; let the weight of the leg rest on the toes. If needed to aid the production of clonus press down with the hand on the knee. It is easy then to start the movement. It may go on for minutes, an entirely unwilled action. While the foot is thus in motion, by grasping the two muscles in turn one can make sure that the soleus alone is actively concerned.

When from spinal disease the soleus reply to a sharp pull gives us the phenomenon of clonic contractions, we are seeing precisely the same reaction which under other mechanical conditions may be evoked in health.

The last proof of this identity is found in the fact that the time (7 to 8 per second), is much the same in normal clonus and in that of disease.

It is clear that the soleus alone is concerned in clonus. But why does not the gastrocnemius itself respond to quick flexion of the foot? The explanation seems to lie largely in the mechanical relations and attachments of the two muscles we are considering.

The gastrocnemius is inserted on the femur; the soleus on the tibia; both by a common tendon on the heel. If the leg be put in extreme passive extension on the thigh the pull made thus on the common tendon is so great as to forbid either muscle's being sharply enough jerked in flexion to occasion muscular response. If now we flex the leg on the thigh, as the gastrocnemius is attached to the femur it will become too relaxed for this to occur. The soleus, however, left independent by reason of its tibial attachments, may then be jerked freely through sudden passive foot flexion and be free to respond, as it does. So long as the common tendon is very tense from the gastrocnemial pull the soleus cannot be jerked by foot flexion. In fact, notwithstanding their common insertion, the soleus and gastrocnemius have rather distinct purposes, as I found well stated in Duchenne's "Electro-Physiologie," p. 424, as follows:

"When the leg is flexed on the thigh the gastrocnemius is so shortened (he should say relaxed) by reason of its upper hold on the femur as to lose almost all power to extend the foot. The soleus, then, because of its attachment to the tibia, is still left competent to extend the foot."

In fact, except when the weight of the body has during walk or station to be lifted on to the toes, these two muscles are independent. But for all the slighter acts of extension the soleus alone is used.

There is possibly another and a singular fact involved in the absence of clonic response by the gastrocnemius. The reply to the sharp pull which causes the knee-jerk, ankle-jerk or clonus is not the same, or equal, in all muscles. Like the muscular response to a blow, it can be had easily in certain muscles and far less readily in others.

Extreme tension is unfavorable to these responses, so also is full relaxation. Hence one additional reason why the gastrocnemius cannot be made to respond in any position may be that it is simply less excitable than the soleus. This normal difference in irritability is true, for example, as to the relative effect of a blow on the extensors and on the flexors of the arm.

The matter I have discussed is, after all, of no great moment, but it is always interesting to find a new clinical fact and to assign symptoms to their correct cause.